

# Long-Term Potassium Fertilization Effects on Yield of Corn and Soybean in South Central Iowa

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### Introduction

Extensive research has been conducted in Iowa to study the potassium (K) fertilization of corn and soybean, but not in south-central Iowa soils. Soil K deficiency decreases crop yield and economic benefits to growers. Also, research in other locations has shown that a K deficiency can reduce the capacity of corn to respond to nitrogen (N) and can increase the incidence of some soybean diseases.

Therefore, a long-term K response study was initiated in 2009 at the McNay Research and Demonstration Farm to study corn and soybean response to K fertilizer.

### Materials and Methods

The study involved two field trials with identical management and design to evaluate treatment effects on both crops of the corn-soybean rotation each year. One site (east field) had predominantly Haig silt loam soil with a small area of Grundy soil. The other site (west field) had Grundy silty clay loam soil. The initial pH and organic matter at these sites were 6.3 to 6.9 and 3.6 to 3.9 percent, respectively. The study included several treatments that have changed over time. From 2009 until 2013, treatments were the combinations of two crop harvest systems and several K application rates. The harvest systems for both crops were grain only harvest, or grain plus crop residue harvest immediately after the grain harvest. The residue was last removed in the fall of 2013, with only grain harvested from all plots in

2014, 2015, and 2016. For the 2009, 2010, and 2011 crop years, the K fertilizer treatments were annual applications of 0, 60, 120, 180, and 240 lb K<sub>2</sub>O/acre. Only the 240-lb treatment was applied for both crops in 2012. For the crops in 2013 and recent years, this annual K treatment was reduced to 120 lb K<sub>2</sub>O/acre. This high and continued rate was designed to avoid yield limitations by insufficient K supply. All plots with corn residues were chisel-plowed in the fall, and all corn and soybean plots were disked or field-cultivated in the spring. Granulated potassium chloride fertilizer (0-0-62) was used, which from 2009 until 2013 was broadcast in the fall and from 2014 until 2016 was broadcast in the spring before disking.

### Results and Discussion

The soil-test K level (6-in. sampling depth) when the experiment started in 2009 was 97 ppm at one site and 104 ppm at the other. These levels are Very Low according to the current Iowa State University (ISU) interpretation categories for the K testing procedure using dried soil samples (see Extension publication PM 1688). Soil-test K for plots receiving no K in any year ranged over time from 102 to 122 ppm with grain harvest and 103 to 109 ppm with both grain and residue harvest. Such temporal variability of soil-test K and little net change over time is commonly observed in low-testing soils. By the fall of 2011, soil-test K of plots that received annual rates of 60 to 240 lb K<sub>2</sub>O/acre with only grain harvest ranged from 126 ppm (upper Very Low category) to 176 ppm (middle Optimum category), and with grain plus residue harvest from 112 ppm (Very Low) to 163 ppm (lower Optimum category). In the fall of 2013, soil-test K of plots that continued receiving the highest, non-limiting

K rate was 224 ppm (High category) with grain harvest and 175 ppm (middle Optimum category) with grain plus residue harvest. By the fall of 2016, after three years of harvesting only grain from all plots, there was no consistent difference in soil-test K between plots having different harvest management in the past. Values ranged from 106 (Very Low category) to 200 ppm (borderline between the Optimum and High categories).

The corn yields for 2010 and 2012 are not included in this report because yields were extremely low and variable due to poor and uneven stands resulting from excessive rainfall in 2010 and drought in 2012. Study of the grain yield response to K fertilization showed the harvest management treatments used until 2013 influenced the yield and soil-test K levels in those years, but not the relative yield increases due to the K rates applied or the yield level in recent years. Therefore, yields shown in this report are averages across the two harvest management treatments, both sites, and for the two most meaningful periods of the study.

Figure 1 shows the average grain yield response for the first three years of the study, when all five treatments were applied. On average, K fertilization increased corn yield by 18 bushels/acre per year and soybean yield by 7 bushels/acre per year. The maximum average corn yield was attained with the annual 180-lb application rate (540 lb total), but the 120-lb rate (360 lb total) maximized soybean yield. The highest annual rate of 240-

lb/acre per year (720 lb total), which was planned as a non-limiting rate, did not increase yield further.

Figure 2 shows the average grain yield response for the entire 8-year period, when different amounts of K were applied over time. On average, K fertilization increased corn yield by 14 bushels/acre per year and soybean yield by 5 bushels/acre per year. The 540-lb amount applied only the first three years was not sufficient to maximize corn yield during the entire 8-year period, and the maximum was attained by the highest, non-limiting, K treatment. However, the difference with 540-lb rate was only 3 bushels/acre. On the other hand, the 540-lb of K applied only the first three years was sufficient to maximize soybean yield during the entire 8-year period.

### **Conclusions**

The study demonstrated the potential of K fertilization to increase corn and soybean grain yield in these low-testing southern Iowa soils. The results also showed when fertilization increases soil-test K to values higher than optimum for these crops, no additional K application is needed for several years.

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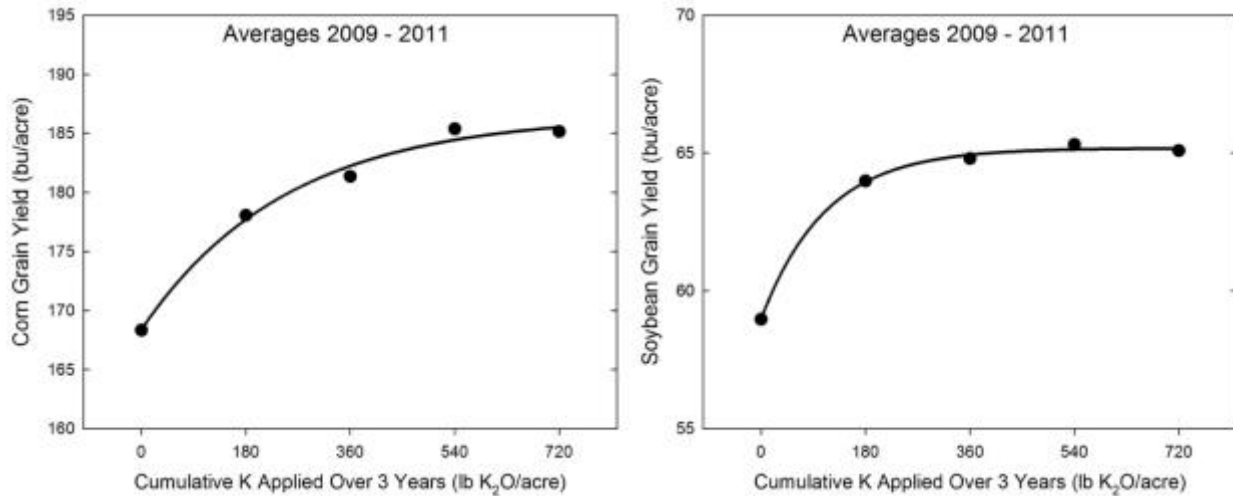


Figure 1. Average corn and soybean grain yield during the first three years of the study as affected by annual rates of 0, 60, 120, 180, and 240 lb K<sub>2</sub>O/acre.

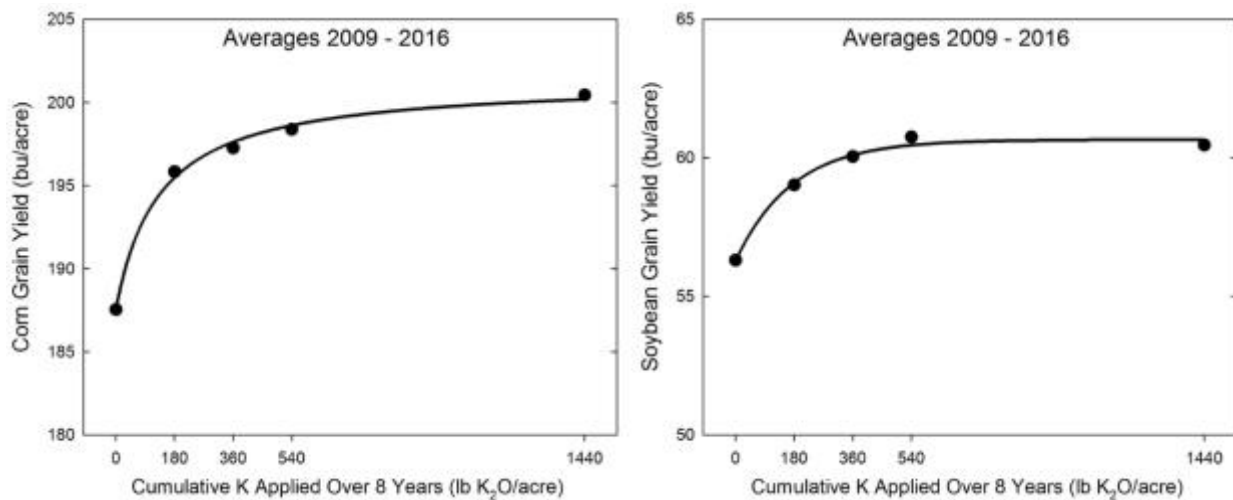


Figure 2. Average corn and soybean grain yield across the entire eight years of the study as affected by K fertilization. The amounts 0, 180, 360, and 540 lb K<sub>2</sub>O/acre are totals applied during the first three years, and the amount of 1,440 lb K<sub>2</sub>O/acre resulted from annual applications of 240 lb K<sub>2</sub>O/acre the first four years and 120 lb K<sub>2</sub>O/acre the last four years.